Discovery learning

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Discovery learning is a technique of inquiry-based learning and is considered a constructivist based approach to education. It is supported by the work of learning theorists and psychologists Jean Piaget, Jerome Bruner, and Seymour Papert. Although this form of instruction has great popularity, there is some debate in the literature concerning its efficacy (Mayer, 2004).

Jerome Bruner is often credited with originating discovery learning in the 1960s, but his ideas are very similar to those of earlier writers (e.g. John Dewey). Bruner argues that "Practice in discovering for oneself teaches one to acquire information in a way that makes that information more readily viable in problem solving" (Bruner, 1961, p. 26). This philosophy later became the discovery learning movement of the 1960s. The mantra of this philosophical movement suggests that we should 'learn by doing'. In 1991, The Grauer School, a private secondary school in Encinitas, California, was founded with the motto, "Learn by Discovery"(r) (Grauer 2016), and integrated a series of world-wide expeditions into their program for high school graduation. (See Expeditionary learning.)

The label of discovery learning can cover a variety of instructional techniques. According to a meta-analytic review conducted by Alfieri, Brooks, Aldrich, and Tenenbaum (2011), a discovery learning task can range from implicit pattern detection, to the elicitation of explanations and working through manuals to conducting simulations. Discovery learning can occur whenever the student is not provided with an exact answer but rather the materials in order to find the answer themselves.

Discovery learning takes place in problem solving situations where the learner draws on his own experience and prior knowledge and is a method of instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments.

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In special needs education

With the push for special needs students to take part in the general education curriculum, prominent researchers in this field doubt if general education classes rooted in discovery based learning can provide an adequate learning environment for special needs students. Kauffman has related his concerns over the use of discovery based learning as opposed to direct instruction. Kauffman comments, to be highly successful in learning the facts and skills they need, these facts and skills are taught directly rather than indirectly. That is the teacher is in control of instruction, not the student, and information is given to students (2002).

This view is exceptionally strong when focusing on students with math disabilities and math instruction. Fuchs *et al.* (2008) comment,

> Typically developing students profit from the general education mathematics program, which relies, at least in part, on a constructivist, inductive instructional style. Students who accrue serious mathematics deficits, however, fail to profit from those programs in a way that produces understanding of the structure, meaning, and operational requirements of mathematics… Effective intervention for students with a math disability requires an explicit, didactic form of instruction…

Fuchs *et al.* go on to note that explicit or direct instruction should be followed up with instruction that anticipates misunderstanding and counters it with precise explanations.

However, few studies focus on the long-term results for direct instruction. Long-term studies may find that direct instruction is not superior to other instructional methods. For instance, a study found that in a group of fourth graders that were instructed for 10 weeks and measured for 17 weeks direct instruction did not lead to any stronger results in the long term than did practice alone (Dean & Kuhn, 2006). Other researchers note that there is promising work being done in the field to incorporate constructivism and cooperative grouping so that curriculum and pedagogy can meet the needs of diverse learners in an inclusion setting (Brantlinger, 1997). However, it is questionable how successful these developed strategies are for student outcomes both initially and in the long term.

Criticism of pure discovery learning

A debate in the instructional community now questions the effectiveness of this model of instruction (Kirschner, Sweller, & Clark, 2006). The debate dates back to the 1950s when researchers first began to compare the results of discovery learning to other forms of instruction (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011).

In support of the fundamental concept of discovery learning, Bruner (1961) suggested that students are more likely to remember concepts if they discover them on their own as opposed to those that are taught directly. This is the basis of discovery learning.

In pure discovery learning, the learner is required to discover new content through conducting investigations or carrying out procedures while receiving little, if any, assistance. "For example, a science teacher might provide students with a brief demonstration of how perceptions of color change depending on the intensity of the light source and then ask them to design their own experiment to further examine this relationship" (Marzano, 2011, p. 86). In this example the student is left to discover the content on his/her own. Because students are left to self-discovery of topics, researchers worry that learning taking place may have errors, misconceptions or be confusing or frustrating to the learner (Alfieri et al., 2011).

While his article is cited as the fundamental framework for discovery learning, Bruner also cautioned that such discovery could not be made prior to or without at least some base of knowledge in the topic (Alfieri et al., 2011). Today's research, like that of Kirschner, Sweller, and Clark (2006) reports that there is little empirical evidence to support pure discovery learning. Specifically, Kirschner et al. suggest that fifty years of empirical data do not support those using these unguided methods of instruction. The meta-analyses conducted by Alfieri and colleagues reconfirmed such warnings.

Mayer (2004) argues that unassisted discovery learning tasks do not help learners discover problem-solving

rules, conservation strategies, or programming concepts. He does acknowledge, however that while under some circumstances constructivist-based approaches may be beneficial, pure discovery learning lacks structure in nature and hence will not be beneficial for the learner.

Mayer also points out that interest in discovery learning has waxed and waned since the 1960s. He argues that in each case the empirical literature has shown that the use of pure discovery methods is not suggested, yet time and time again researchers have renamed their instructional methods only to be discredited again, to rename their movement again.

Additionally, several groups of educators have found evidence that pure discovery learning is less effective as an instructional strategy for novices, than more direct forms of instruction (e.g. Tuovinen & Sweller, 1999). Mayer asked the question "Should There Be a Three-Strikes Rule Against Pure Discovery Learning?" While discovery for oneself may be an engaging form of learning, it may also be frustrating.

The main idea behind these critiques is that learners need guidance (Kirschner et al., 2006), but later as they gain confidence and become competent then they may learn through discovery.

Effects on cognitive load

Research has been conducted over years (Mayer, 2001; Paas, Renkl, & Sweller, 1999, 2004; Winn, 2003) to prove the unfavorable effects of discovery learning, specifically with beginning learners. "Cognitive load theory suggests that the free exploration of a highly complex environment may generate a heavy working memory load that is detrimental to learning" (Kirschner, Sweller, Clark, 2006). Beginning learners do not have the necessary skills to integrate the new information with information they have learned in the past. Sweller reported that a better alternative to discovery learning was guided instruction. According to Kirschner, Sweller and Clark (2006), guided instruction produces more immediate recall of facts than unguided approaches along with longer term transfer and problem-solving skills.

Enhanced discovery learning

Robert J. Marzano (2011) describes enhanced discovery learning as a process that involves preparing the learner for the discovery learning task by providing the necessary knowledge needed to successfully complete said task. In this approach, the teacher not only provides the necessary knowledge required to complete the task, but also provides assistance during the task. This preparation of the learner and assistance may require some direct instruction. "For example, before asking students to consider how best to stretch the hamstring muscle in cold weather, the teacher might present a series of lessons that clarify basic facts about muscles and their reaction to changes in temperature" (Marzano, 2011, p. 87).

Another aspect of enhanced discovery learning is allowing the learner to generate ideas about a topic along the way and then having students explain their thinking (Marzano, 2011). A teacher who asks the students to generate their own strategy for solving a problem may be provided with examples in how to solve similar problems ahead of the discovery learning task. "A student might come up to the front of the room to work through the first problem, sharing his or her thinking out loud. The teacher might question students and help them formulate their thinking into general guidelines for estimation, such as "start by estimating the sum of the highest place-value numbers." As others come to the front of the room to work their way through problems out loud, students can generate and test more rules" (Marzano, 2011, p. 87).

See also

- Active learning
- Cognitive load
- Constructivism (learning theory)
- Inquiry-based learning
- Jerome Bruner
- Problem-based learning
- Progressive education
- Moore method

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External links

- The Discovery Learning Project at the College of Natural Sciences of the University of Texas at Austin (http://www.discovery.utexas.edu)

Wikiversity has learning materials about ***Discovery learning***

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